Patented May 22, 1934

1,959,758

UNITED STATES PATENT OFFICE

1,959,758

FREE CUTTING STEEL

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No. Drawing. Application March 13, 1933, Serial No. 660,462

6 Claims. (Cl. 75—1)

This invention relates to free cutting steels and while herein described with particular reference to steels designated in the trade as "free cutting" and used for the manufacture of screws and the like, is applicable generally to steels of other compositions.

Except for the purpose of improving the machinability, sulphur has generally been regarded as an impurity in steel, and with this exception has usually been held as low as is conveniently possible. In ordinary Bessemer practice the sulphur content may range from .030 to .050 percent, while in ordinary open hearth practice it may vary from .025 to .050 percent. The quality of machinability is generally better in Bessemer steel than in open hearth steel; but, nevertheless, the practice has been to add sulphur in considerable quantity to Bessemer steel for the manufacture of screw stock.

Our invention is applicable not only to screw stock, but also to steels of lower sulphur content. For example, it may be used in steels having a sulphur content within the range permitted by the usual steel specifications, so that by its use steels may be made within such specifications and yet have enhanced free cutting qualities.

In the making of screw stock the sulphur addition is generally made by throwing flowers of sulphur or stick sulphur into the ladle. We have found that highly improved results may be obtained by adding the sulphur to the steel in another form; and even though a steel is made according to our invention and containing sulphur no greater in amount than that in another steel wherein the sulphur has been added in the usual fashion, that made according to our invention is vastly superior from the standpoint of free cutting quality.

We add the sulphur to the steel in combined form, preferably in the form of an oxygen containing sulphur compound. Specifically, we prefer to use $FeSO_4$. Other oxygen containing sulphur compounds, and particularly other solid sulphates, may be used. For example, we have successfully employed ammonium sulphate, but in using this material care should be taken to avoid undue segregation.

We have successfully used ferrous sulphate by adding it to the ladle in the amount of five pounds per ton, but the amount may be varied depending on the sulphur content desired in the final product. It need not be added entirely in the ladle. For example, it may be added to the steel in the ingot mold or part may be charged to the ladle and part to the ingot mold.

Our improved steel is processed in the ordinary way. So far as we are now aware, no special precautions in manufacture need be taken, the steel being handled like any other steel of similar composition.

Any desired sulphur content may be had, but, as stated, it is found that the product is superior to steels of identical sulphur content made by orthodox processes. This will be shown by reference to screw steels. It is common in screw steels to make the sulphur content from .120 to .180 percent, and in recent years attempts have been made to improve the machinability by increasing the sulphur content above .180%, the sulphur content in some cases being .30% or even higher. In these ranges we have found that the machinability, as measured by increase in production of machined parts, may be as high as 33⅓%.

The advantages of our invention may be further appreciated from the results of other tests. In one case a tool cutting Bessemer screw stock made according to the usual processes required resharpening after 125 minutes of service; whereas the substitution of our improved steel resulted in a tool life of 256 minutes before resharpening was necessary. In another extended test regular Bessemer screw stock was being cut at a surface speed of 147 feet per minute with a feed of .0042 inches per revolution. The parts being manufactured required 30 seconds per piece for production and the tool life was four hours. The number of approved parts produced in twelve hours was 800. The substitution of our improved steel made it possible to increase the cutting speed to 209 feet per minute with the same rate of feed. The cutting time per piece was reduced to 20 seconds, and the tool life was increased to eight hours. The number of approved parts in twelve hours was increased to 1597, a production increase of 99.6%. It is probable that the rate of production could have been still further increased but the screw machine on which the tests were being made was not sufficiently heavy and undue vibration occurred on attempts at further speeding up.

It is not essential that the sulphur content be as high as in the above examples, and, as stated, the invention is applicable to all steels. It may be desirable, for instance, to use open hearth steel and the purchaser may require that the sulphur content be within accepted limits for general use. For example, he may require that the sulphur

content be not over .05%. In such case, the steel may be made in the open hearth furnace with a low sulphur content, say, .025–.030%, and the remaining sulphur added in the form of $FeSO_4$. This will improve the machining qualities while still leaving the analysis within the range customarily specified.

We have described a present preferred embodiment of our invention. It will be understood, however, that this is by way of illustration only and that it may be otherwise embodied or practiced within the scope of the following claims.

We claim:

1. In the method of improving the free cutting quality of steel, the steps consisting in melting the steel and adding sulphur to the molten steel in the form of a solid sulphate and in such amount that the finished steel contains sulphur in excess of .025%.

2. In the method of improving the free cutting quality of steel, the steps consisting in melting the steel and adding sulphur to the molten steel in the form of a solid sulphate selected from the group comprising ferrous sulphate and ammonium sulphate and in such amount that the finished steel contains sulphur in excess of .025%.

3. In the method of improving the free cutting quality of steel, the steps consisting in melting the steel and adding sulphur to the molten steel in the form of ferrous sulphate and in such amount that the finished steel contains sulphur in excess of .025%.

4. As a new manufacture, steel having enhanced free cutting qualities, which steel is the product of a process wherein steel is melted and sulphur is added to the molten steel in the form of a solid sulphate in such amount that the finished product contains sulphur in excess of .025%.

5. As a new manufacture, steel having enhanced free cutting qualities, which steel is the product of a process wherein steel is melted and sulphur is added to the molten steel in the form of a solid sulphate selected from the group comprising ferrous sulphate and ammonium sulphate and in such amount that the finished steel contains sulphur in excess of .025%.

6. As a new manufacture, steel having enhanced free cutting qualities, which steel is the product of a process wherein steel is melted and sulphur is added to the molten steel in the form of ferrous sulphate in such amount that the finished steel contains sulphur in excess of .025%.

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